Claims

1. A gas purification system comprising:

a reactor having a volume and a wall, the wall having an interior side and an exterior side, and a communicating portal therebetween for a mixed gas flow;

a reaction catalyst coating in contact with the interior side of the wall;

a gas selective membrane within the reactor volume, said gas membrane in contact with the mixed gas flow and selectively passing a constituent gas of the mixed gas flow therethrough, whereby a raffinate of the mixed gas flow is retained in contact with said membrane;

an outlet channel for removing said raffinate from contact with said selective membrane; and

a passageway for the removal of the constituent gas from the interior of said reactor.

2. The gas purification system of claim 1 further comprising a heater in thermal contact with said reactor.

3. The gas purification system of claim 1 further comprising a space between the reaction catalyst coating and the membrane.

4. The gas purification system of claim 3 wherein the space ranges from 0.05 inch to 1.0 inch.

5. The gas purification system of claim 3 wherein the space ranges from 0.3 inch to 0.6 inch.

6. The gas purification system of claim 3 wherein the space comprises a flow distributor.

7. The gas purification system of claim 6 wherein the flow distributor is selected from the group consisting of: packing, particulate, mesh wire, wool, granule, pellet and fluidized catalyst.

8. The gas purification system of claim 6 wherein the flow distributor is a multichannel monolith.

9. The gas purification system of claim 8 wherein the multichannel monolith has channels ranging in diameter from 10 micrometers to 1 millimeter.

10. The gas purification system of claim 8 wherein the multichannel monolith has channels ranging in diameter from 50 micrometers to 500 micrometers.

11. The gas purification system of claim 8 wherein the monolith channels are coated.

12. The gas purification system of claim 8 wherein the monolith channels are coated with a reaction catalyst.

13. The gas purification system of claim 8 wherein the monolith channels are coated with a selective membrane.

14. The gas purification system of claim 8 wherein the monolith is bonded to the reactor wall such that heat is conducted from the wall exterior to the wall interior.

15. The gas purification system of claim 8 wherein the heating means comprises a combustion catalyst.

16. The gas purification system of claim 15 wherein the combustion catalyst is on the exterior wall of the reactor.

17. The gas purification system of claim 15 wherein the combustion catalyst is on the exterior wall of a feed tube.

18. The gas purification system of claim 1 further comprising a flow disruptor.

19. The gas purification system of claim 18 wherein the flow disruptor is selected from the group consisting of: a bump, a protrusion, a baffle and a helical tube.

20. The gas purification system of claim 2 wherein the heating means comprises a sweep gas.

21. The gas purification system of claim 20 wherein the sweep gas is inert.

22. The gas purification system of claim 21 wherein the sweep gas is steam.

23. The gas purification system of claim 1 further comprising partial pressure decreasing means.

24. The gas purification system of claim 23 wherein the partial pressure decreasing means is sweep gas flow.

25. The gas purification system of claim 1 further comprising feed liquid compression means.

26. The gas purification system of claim 1 wherein the membrane is tubular.

27. The gas purification system of claim 1 further comprising a plurality of the membranes.

28. The gas purification system of claim 1 wherein the membrane is hydrogen selective and the constituent gas is hydrogen.

29. The gas purification system of claim 1 wherein the catalyst coating comprises a methanol reforming catalyst.

30. The gas purification system of claim 1 wherein the catalyst coating comprises an ammonia cracking catalyst.

31. The gas purification system of claim 1 wherein heat is provided by catalytic combustion.

32. The gas purification system of claim 1 wherein said reactor further comprises a heat transfer fin on the exterior surface thereof.

33. A gas purification system comprising:

a reactor operating above room temperature having a volume and a wall, the wall having an interior side and an exterior side, and a communicating portal therebetween for a mixed gas flow;

a gas selective membrane within the reactor volume, said gas membrane in contact with the mixed gas flow and selectively passing a constituent gas of the mixed gas flow therethrough, whereby a raffinate of the mixed gas flow is retained in contact with said membrane;

an outlet channel for removing said raffinate from contact with said selective membrane;

a catalyst in contact with the exterior side of said reactor that induces an exothermic combustion reaction with the raffinate; and

a passageway for the removal of the constituent gas from the interior of said reactor.

34. The gas purification system of claim 33 further comprising an insulating jacket surrounding said reactor, the jacket having an oxygen containing gas flowing therethrough.

35. The gas purification system of claim 33 further comprising a plurality of the membranes.

36. The gas purification system of claim 33 wherein the membrane is hydrogen selective and the constituent gas is hydrogen.

37. The gas purification system of claim 33 wherein the membrane is a tube membrane.